REMARKS

In view of the following arguments and clarifications, it is respectfully submitted that the applicant amended the claims according to the Examiner's suggestions in the amendment filed on 5 December 2008, and therefore, should be in condition for allowance.

In response to the office action mailed on 9 September 2008, applicant amended the claims as suggested by the Examiner. Specifically, the Examiner indicated that claim 12 would be allowable if rewritten in independent form and including all the limitations of the base claim and any intervening claims. The applicant did just that. Independent claim 1 was amended to replace "bar-link drive" with "slider-crank mechanism", and claim 12 cancelled. Dependent claim 12 also depended from cancelled claim 11 that claimed the "bar-link drive" was a "four bar-link drive". The terms "bar-link drive", "four bar-link drive", and "slider-crank mechanism", are well-known, defined terms for mechanical drives. Simply put, a slider-crank mechanism is a subset or particular type of four bar-link drive and a four bar-link drive is a subset or particular type of bar-link drive; therefore by substituting "slider-crank mechanism" for "bar-link drive" in claim 1, by definition "slider-crank mechanism" incorporates the limitations of a bar-link drive and a four bar-link drive. Therefore, amended claim 1 should be allowable over the prior art. The other dependent claims 2-10 and 13-23 should also be allowable and the same arguments apply to the remaining pending claims 28-31 and 34-36. The phrase "four bar-link drive" is not necessary to be specifically called out in claim 1, because by definition, a slider-crank is a particular type of four bar-linkage.

The terms “bar-link drive”, “four bar-link drive”, and “slider-crank mechanism” are terms of art and are not terms fabricated by the applicants. As shown in the reference materials attached to the response filed 18 December 2007, and again attached to this Request, it is clear that a slider-crank mechanism is a particular type of drive that is different from the cited prior art, including Amano et al. The specification at p. 7, paragraph 24, penultimate sentence, set forth that a slider-crank is a type of four bar-linkage. Amano discloses a parallelogram linkage, as shown in the Wikipedia reference attached to this Request and also previously submitted. The specification at p. 15-16, paragraph 40, sets forth at least one advantage of the slide-crank mechanism – the ability to provide different translation paths across the patient’s eye by simply using different suction rings.

Because slider-crank is a defined term of art, it is respectfully submitted that the Examiner's arguments that Amano and Hellenkamp each anticipate the presently pending claims because each teaches a slider-crank mechanism is simply and clearly wrong. As is clear from the attached reference materials, Amano discloses a parallelogram linkage that is different from a slider-crank linkage. Similarly, Hellenkamp, as previously stated, is not any type of four bar-linkage but rather is a rack and pinion drive. None of the prior art provides the stated advantages of the claimed slider-crank mechanism. Based on the clarifications provided in this Request, applicants will not go into specific detail pointing out the errors made contorting the prior art to attempt to establish that the present invention is anticipated; rather the above arguments and reference materials make it clear that the prior art simply does not teach the use of a slider-crank mechanism in a microkeratome, as specifically claimed.

During the telephone conference, the Examiner requested that these arguments be set forth in writing so that he could present them clearly to his supervisor. It is respectfully requested that if this Request is not persuasive, that the Examiner notify the undersigned prior to 10 June 2009, so that an appeal can be filed without the need for any extensions of time. The undersigned will call the Examiner next week, as requested, to remind the Examiner that this Request is pending.

Also, multiple attempts have been made to follow-up on the status of adding an additional inventor to this application. Please confirm that this has been completed.

Respectfully Submitted,

Michael L. Smith

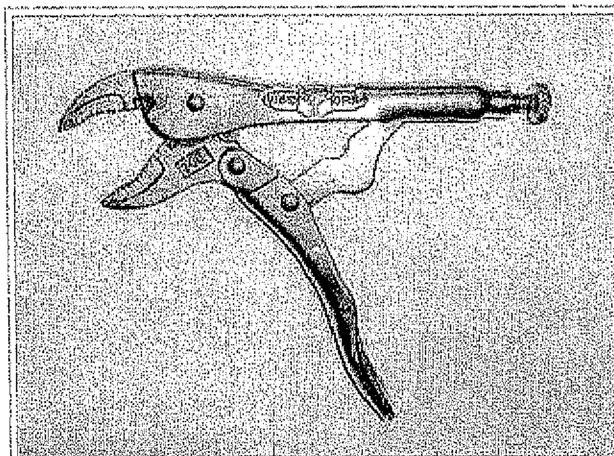
DATE: May 22, 2009

HARNESS, DICKEY & PIERCE, P.L.C.
7700 Bonhomme, Ste. 400
St. Louis, MO 63105
(314) 726-7500

MLS:csy

Linkage (mechanical)

From Wikipedia, the free encyclopedia



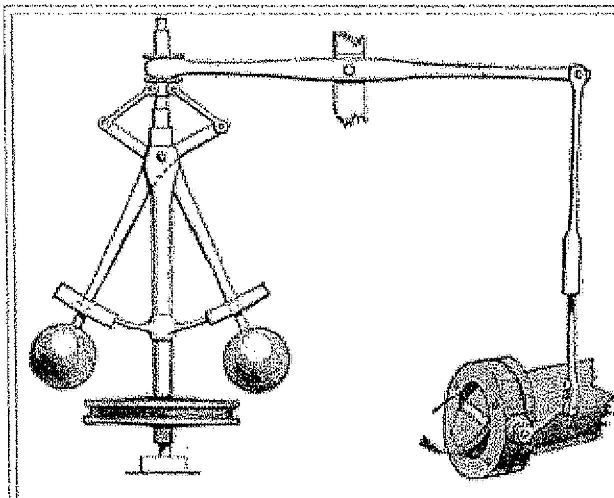
Locking pliers exemplify a four-bar, one degree of freedom mechanical linkage; or a five-bar, two DOF linkage when the adjustment screw is considered.

Mechanical linkages are a series of rigid links connected with joints to form a closed chain, or a series of closed chains. Each link has two or more joints, and the joints have various degrees of freedom to allow motion between the links. A linkage is called a mechanism if two or more links are movable with respect to a fixed link. Mechanical linkages are usually designed to take an input and produce a different output, altering the motion, velocity, acceleration, and applying mechanical advantage.

A linkage designed to be stationary is called a structure.

Contents

History



A flyball governor for flow control. A water turbine spins the governor, which controls the water flow, which feeds the turbine, creating a speed-regulated machine.

Mechanical linkages are a fundamental part of machine design, and yet many simple linkages were not well understood nor invented until the 19th century. Consider a stick: it has six degrees of freedom, three of which are the coordinates of its centre in space, the other three describing its rotation. Once nudged between a boulder and fulcrum it is constrained to a particular motion, to act as a lever to move the boulder. When more links are added and joined in various ways their collective motion can be further defined. Very complicated and precise motions can be designed into a linkage with only a few parts.

The Industrial Revolution was the golden age of mechanical linkages. Mathematical, engineering and manufacturing advances provided both the need and the ability to create new mechanisms. Many simple mechanisms that seem obvious today required some of the greatest minds of the era to create. Leonhard Euler was one of the first mathematicians to study linkage synthesis, and James Watt worked very hard to invent the Watt linkage to support his steam engine's piston. Chebyshev worked on mechanical linkage design for over thirty years, which led to his work on polynomials[2]. New linkage inventions, designed by need, were instrumental in cloth making, power conversion and speed regulation. Even the ability of a mechanism to produce accurate linear motion, without a reference guide way, took years to solve.

Scientists, mostly German, Russian and English, have researched this domain over the last 200 years, so that today most traditional analysis or synthesis problems (e.g. planar movement) have been solved (see online libraries under External links). Recently, compliant structures have come to the fore.

Electronic technology has replaced many linkage applications taken for granted today, such as mechanical computation, typewriting and machining. However, modern linkage design continues to advance, and designs that used to occupy an engineer for days are now optimized with a computer in seconds.

Even though servomechanisms with digital control are common, and at first glance easy to use, some motion problems (especially for quick and accurate movements) are still only soluble using linkages and cams.

Theory

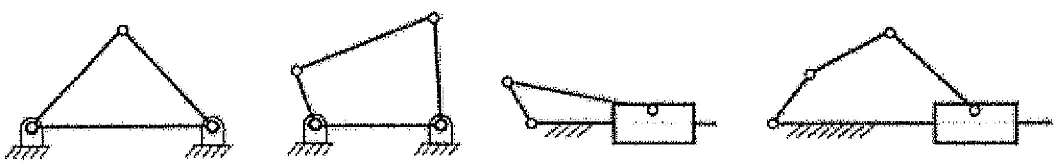
The most common linkages have one degree of freedom, meaning that there is one input motion that produces one output motion. Most linkages are also planar, meaning all the motion takes place in one plane. Spatial linkages (non-planar) are more difficult to design and therefore not as common.

Kutzbach-Gruebler's equation is used to calculate the degrees of freedom of linkages. The number of degrees of freedom of a linkage is also called its *mobility*.

A simplified version of the Kutzbach-Gruebler's equation for planar linkages :

$$M = 3(n-1) - 2j$$

m= mobility = degrees of freedom
n= number of links (including a single ground link)
j= number of one-degree-of-freedom kinematic pairs (pin or slider joints)



Truss
n=3, f=3, m=0

Four-bar linkage
n=4, f=4, m=1

Crank-slider
n=4, f=4, m=1

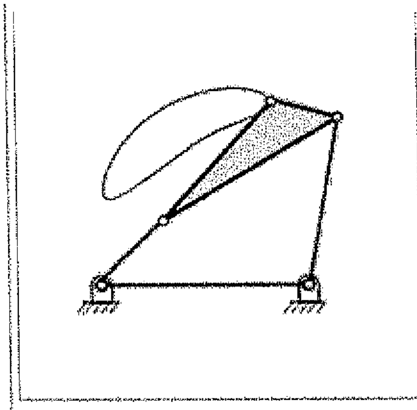
Five-bar linkage
n=5, f=5, m=2

The mobility of hydraulic machinery can easily be identified by counting the number of independently controlled hydraulic cylinders.

Types of common joints:

- **Pin**, one DOF rotation. Examples are; bushings, bearings, bolted joints, rivets and hinges.
- **Slider**, one or two DOF linear motion. Examples are; linear bearings, hydraulic cylinders, rollers and pistons.
- **Ball and socket**, three DOF rotation, usually restricted to one DOF by other joints in the mechanism.

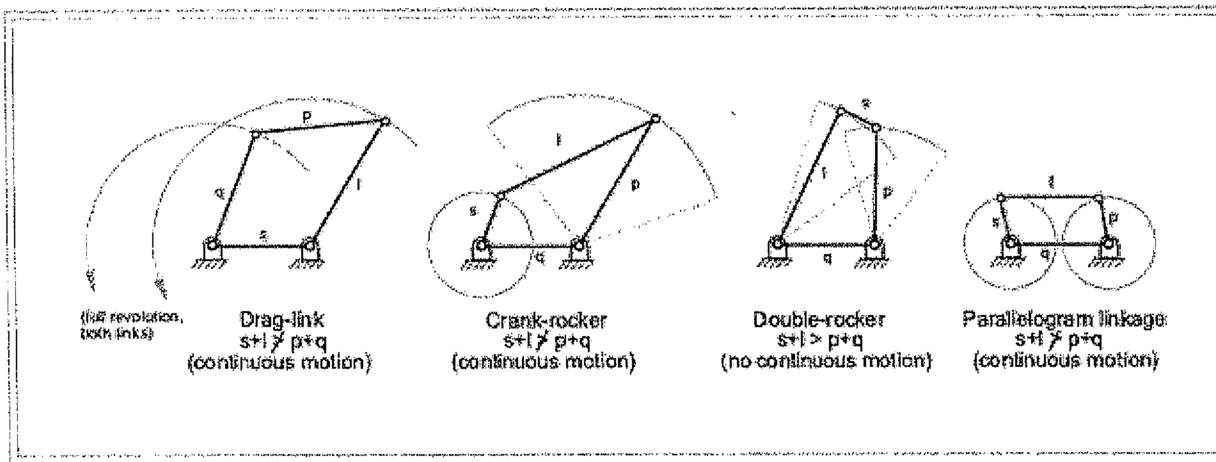
Designers will synthesize a linkage by starting with the required output motion, mechanical advantage, velocity and acceleration. A type of linkage is chosen and modified to deliver the required performance.


Simple linkages are capable of producing complicated motion.

Each link is treated as a vector and the vectors can be combined into a system of equations because they form a loop. The matrix is solved to create a closed form equation that relates input motion to output motion. The same is done for mechanical advantage, or any other important quantity. The equations of motion are differentiated with respect to time to find velocity and acceleration of the mechanism parts.

Types of linkages

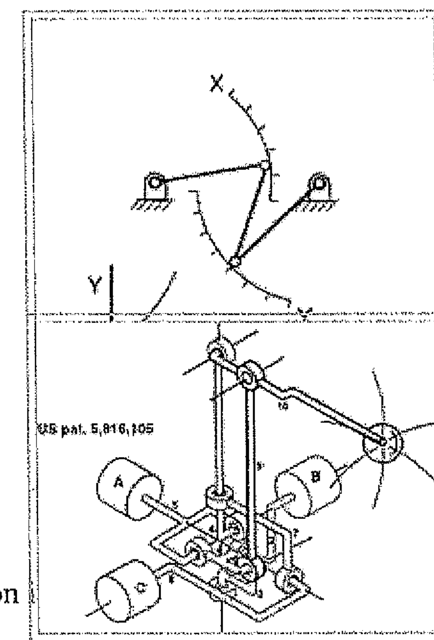
Four bar linkages are the simplest closed loop kinematic linkage. They perform a wide variety of motions with a few simple parts. They were also popular in the past due to the ease of calculations, prior to computers, compared to more complicated mechanisms.



Types of four bar linkages, s = shortest link, l = longest link

Other notable types of linkages;

- Pantograph (four-bar, two DOF)
- Crank-slider, (four-bar, one DOF)
- Grashof, (four-bar, one DOF) At least one link can rotate 360°
- Five bar linkages often have meshing gears for two of the links, creating a one DOF linkage. They can provide greater power transmission with more design flexibility than four bar linkages.
- Six bar, single DOF linkages offer greater design flexibility than four bar linkages, but require more parts and are more difficult to design. [3] ;
  - Watt kinematic chain
  - Watt I, II
  - Stephenson kinematic chain
  - Stephenson I, II, III
- Peaucellier-Lipkin linkage, the first linkage to create a straight line output from rotary input; eight-bar, one DOF.
- Extending linkages (e.g. scissors linkage), which allow great reach by a relatively compact mechanism.
- A Scott Russell linkage, which converts linear motion, to (almost) linear motion



input.

Uses

A spatial 3DOF linkage for joystick applications.

Linkages are primarily used as machine components and tools. Typical examples are automotive suspensions and bolt cutters. The internal combustion engine's piston/rod/crank is a classic four-bar linkage with one degree of freedom. Linkages are often the simplest, least expensive and most efficient mechanism to perform complicated motions.

One highly visible application is the windshield wiper: a four bar linkage changes the motor's rotary motion to oscillation. Some wipers also have a second set of four bar linkages to keep the wiper blades oriented correctly as they sweep. Another visible application is heavy equipment which makes extensive use of four and six bar linkages.

Spatial linkages are becoming more common due to computer aided design.

"The 4-Bar Linkage" is an adapted mechanical linkage used on bicycles. With a normal full-suspension bike like an Apollo Creed, the suspension means that the back wheel moves in a very tight arc shape. This means that more power is lost when going uphill. With a bike fitted with a 4-Bar Linkage, like a Diamondback S10, the wheel moves in such a large arc that it is moving almost vertically. This way the power loss is reduced by up to 30%.

References

1. Erdman, Arthur G.; Sandor, George N. (1984). *Mechanism Design: Analysis and Synthesis*. Prentice-Hall. ISBN 0-13-572396-5.
2. How to Draw a Straight Line, historical discussion of linkage design (http://kmoddl.library.cornell.edu/tutorials/04/)
3. What is a Watt I Linkage? (http://www.mines.edu/fs_home/dgolson/WattOneB.html)

See also

- Engineering mechanics
- Cam
- Kinematic pairs
- Overconstrained Mechanisms
- Machine
- Three-point hitch
- Lever
- Parallel motion

External links

- An (at present mainly German) online library about linkages and cams is available through Digital Mechanism Library (DMG-Lib) (http://www.dmg-lib.de/) (in German: Digitale Mechanismen- und Getriebebibliothek)
- With KMODDL (http://kmoddl.library.cornell.edu/) there is also an English online library (contains foreign literature too)
- Linkage calculations (http://www.roymech.co.uk/Useful_Tables/Mechanics/Linkages.html)
- Java animated linkages (http://www.math.toronto.edu/~drorbn/People/Eldar/thesis/index.html)
- Gif animated linkages (http://www.math.ntnu.edu.tw/~jcchuan/demo/gear/machine.html)
- MIT Open Course ware, Matlab code for four bar linkages (http://ocw.mit.edu/NR/rdonlyres/Mechanical-Engineering/2-007Design-and-Manufacturing-ISpring2003/AD195F9C-EB6D-42AA-9C39-

27B0EB1D7C3A/0/fourba...n)
- Introductory Linkage Lecture, 2MB PDF (http://pergatory.mit.edu/2.007/lectures/2002/Lectures/Topic_04_Linkages.pdf)
- Virtual Mechanisms Animated by Java (http://www.brockeng.com/mechanism/index.htm)
- SAM (http://www.artas.nl/) User-friendly software for design, motion/force analysis & optimization of planar linkage, gear and belt mechanisms

Retrieved from "http://en.wikipedia.org/wiki/Linkage_%28mechanical%29"

Category: Linkages

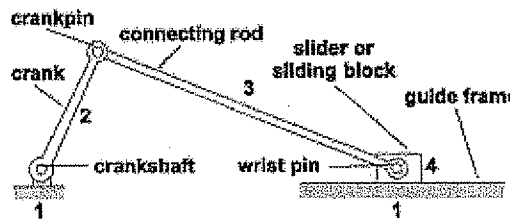
Answers.com™
Technology

Slider-crank mechanism

Sci-Tech Encyclopedia

Slider-crank mechanism

A four-bar linkage with output crank and ground member of infinite length. A slider crank (see illustration) is most widely used motion (as in an engine) or to convert rotary to reciprocating motion (as in pumps), but it has numerous other applications. Pos are called dead centers. When crank and connecting rod are extended in a straight line and the slider is at its maximum distanc position is top dead center (TDC); when the slider is at its minimum distance from the axis of the crankshaft, the position is bo



Principal parts of slider-crank mechanism.

The conventional internal combustion engine employs a piston arrangement in which the piston becomes the slider of the slide aircraft employ a single master connecting rod to reduce the length of the crankshaft. The master rod, which is connected to t conventional slider-crank mechanism. The other pistons are joined by their connecting rods to pins on the master connecting r

To convert rotary motion into reciprocating motion, the slider crank is part of a wide range of machines, typically pumps and c crank is in toggle mechanisms, also called knuckle joints. The driving force is applied at the crankpin so that, at TDC, a much l *See also* Four-bar linkage.

Four bar linkage

From Wikipedia, the free encyclopedia

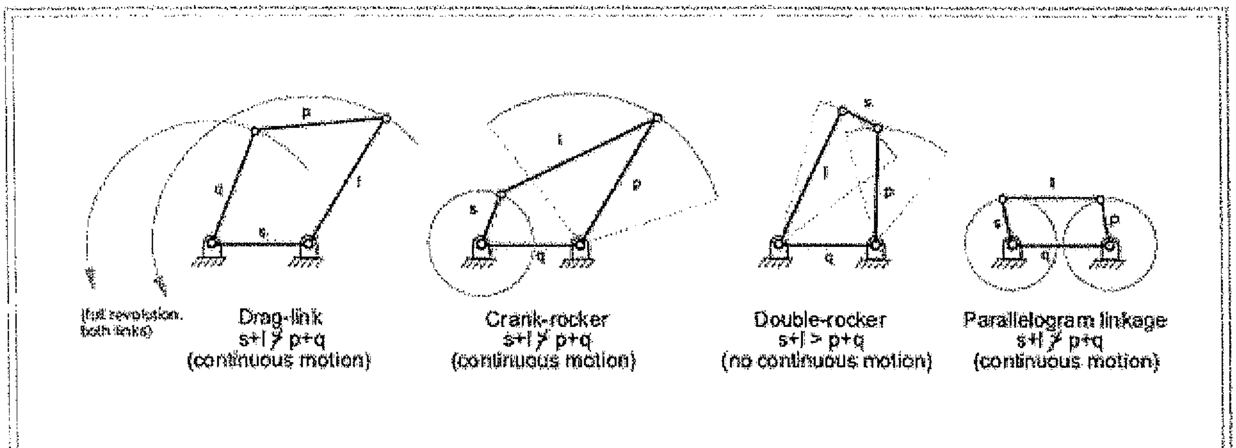
A **four bar linkage** or simply a **4-bar** or **four-bar** is the simplest movable linkage. It consists of 4 rigid bodies (called bars or links), each attached to two others by single joints or pivots to form a closed loop.

Four-bars are simple mechanisms common in mechanical engineering machine design and fall under the study of kinematics.

If each joint has one rotational degree of freedom (i.e., it is a pivot), then the mechanism is usually planar, and the 4-bar is determinate if the positions of any two bodies are known (although there may be two solutions). One body typically does not move (called the **ground link**, **fixed link**, or the **frame**), so the position of only one other body is needed to find all positions. The two links connected to the ground link are called **grounded links**. The remaining link, not directly connected to the ground link, is called the **coupler link**. In terms of mechanical action, one of the grounded links is selected to be the **input link**, i.e., the link to which an external force is applied to rotate it. The second grounded link is called the **follower link**, since its motion is completely determined by the motion of the input link.

Planar four-bar linkages perform a wide variety of motions with a few simple parts. They were also popular in the past due to the ease of calculations, prior to computers, compared to more complicated mechanisms.

Grashof's law is applied to pinned linkages and states; *The sum of the shortest and longest link of a planar four bar linkage cannot be greater than the sum of remaining two links if there is to be continuous relative motion between the links.* Below are the possible types of pinned, four-bar linkages;



Types of four bar linkages, s = shortest link, l = longest link

Notable four-bar linkages

- If the input link may rotate full 360 degrees, it is called a **crank**. The linkage is called a **crank-rocker** if the input link is a crank and the opposite link is a rocker. If the opposite link is also a crank the linkage is called a **double-crank**.
- Pantograph (four-bar, two degrees of freedom, i.e., only one pivot joint is fixed.)
- **Crank-slider**, (four bar, one degree of freedom)

External links

- mechanisms101.com (http://www.mechanisms101.com/fourbar01.html)- Flash Four-bar Linkages simulator

- softintegration.com (http://www.softintegration.com/chhtml/toolkit/mechanism/fourbar/)- Animated GIF Four-bar linkage with triangular coupler link

Retrieved from "http://en.wikipedia.org/wiki/Four_bar_linkage"

Categories: Kinematics | Linkages